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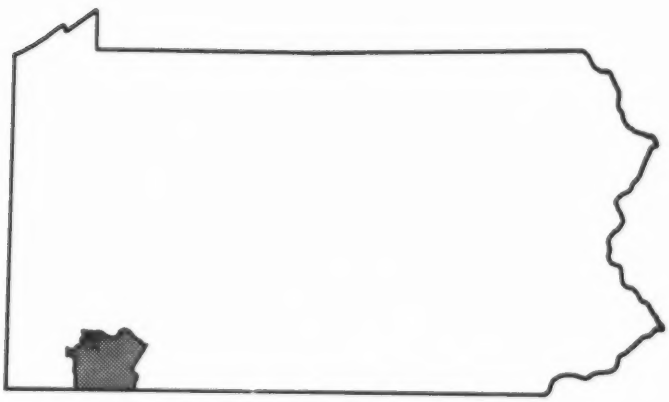
FLOOD INSURANCE STUDY

BOROUGH OF BELLE VERNON, PENNSYLVANIA
FAYETTE COUNTY



JANUARY 16, 1981

federal emergency management agency
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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Borough of Belle Vernon, Fayette County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Belle Vernon to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by GAI Consultants, Inc., for the Federal Insurance Administration, under Contract No. H-4762. This study was completed in December 1979.

1.3 Coordination

An initial Consultation and Coordination Officer's (CCO) meeting was held on April 3, 1978, and was attended by representatives of the Borough of Belle Vernon, the FIA, and GAI Consultants, Inc. (the study contractor). The Pittsburgh District of the U. S. Army Corps of Engineers (COE), the U. S. Geological Survey (USGS), the Southwestern Pennsylvania Regional Planning Commission and borough representatives were contacted throughout the course of the study to obtain information.

The results of this study were reviewed at the final CCO meeting held on July 14, 1980, attended by representatives of the FIA, the study contractor and the Borough of Belle Vernon.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Borough of Belle Vernon, Fayette County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The Monongahela River is the main source of flooding in Belle Vernon. Detailed methods of analysis were used to study the Monongahela River for its entire 0.9-mile length contiguous to Belle Vernon. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction for the next five years, through December 1984.

2.2 Community Description

Belle Vernon was first settled in 1772 and was incorporated in 1813. It is located in southwestern Pennsylvania, approximately 23 miles south-southeast of Pittsburgh, Pennsylvania. Belle Vernon is bordered to the west by the Township of Rostraver in Westmoreland County, the Borough of North Belle Vernon to the north, the Township of Washington, Fayette County, to the east, and the Boroughs of Speers and Dunlevy in Washington County to the south. The population of Belle Vernon has been steadily decreasing from 1,784 in 1960 to 1,496 in 1970 to a 1975 estimate of 1,408 (Reference 1).

The Borough of Belle Vernon occupies 0.3 square mile in Fayette County, 25 percent of which is non-residential development, primarily industrial areas located along the Monongahela River. Commercial supplies produced by industries in Belle Vernon include lumber and mining machinery (Reference 1). The remaining area is occupied by residential development and vacant lots. There is no crop, pasture or forest land within the borough (Reference 2).

Elevations in the borough range from approximately 740 feet on the Monongahela River flood plain to 1,100 feet near the eastern corporate limits, for a total relief of 360 feet.

The climate of Pennsylvania is generally considered to be humid continental, but both the climate and weather can be highly variable due to

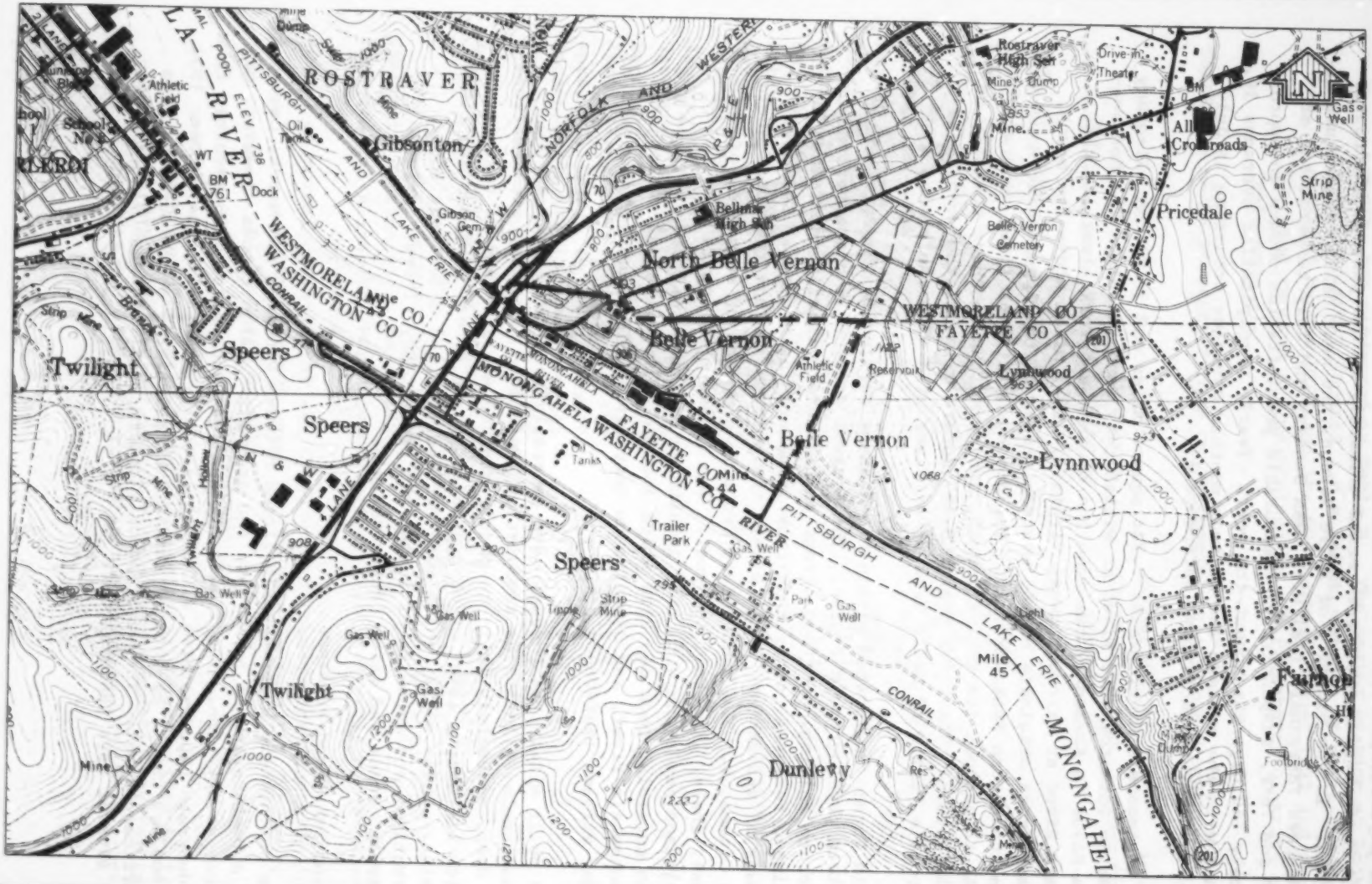


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF BELLE VERNON, PA
(FAYETTE CO.)

VICINITY MAP

local physiographic features. In southwestern Pennsylvania, frequent and rapid changes in weather are caused primarily by the passage of frontal systems. In the vicinity of Belle Vernon, the mean daily temperature is 55 degrees Fahrenheit (°F) with mean January and July temperatures of 34°F and 76°F, respectively. Measurable precipitation occurs on approximately 160 days throughout the year. Yearly precipitation averages 38.0 inches with the maximum and minimum monthly averages occurring in July and February, respectively (Reference 3).

The Monongahela River drains 7,384 square miles and joins the Allegheny River to form the Ohio River at Pittsburgh, Pennsylvania. The Monongahela River is formed by the junction of the West Fork River and the Tygart River at Fairmont, West Virginia, 128.7 miles above its mouth. These rivers originate on the western slopes of the Appalachian Mountains in northwestern West Virginia. The Monongahela River flows generally north throughout its entire length, and forms the southern boundary of Belle Vernon. The river drains 5,187 square miles at the downstream corporate limits of Belle Vernon, at river mile 43.3 (Reference 4).

Belle Vernon is located within the Kanawha section of the Appalachian Plateau physiographic region. The Kanawha section is characterized by moderate folding. Surface irregularities are primarily determined by the drainage features rather than rock structure in the area. Geologic groups of sedimentary rocks within the borough include the Monongahela and Conemaugh. The Monongahela Group is composed of sequences of sandstone, shale, limestone and coal. The Conemaugh Group is composed of shale and sandstone with thin limestones and thin coal beds. There are also surficial rock deposits which include alluvial deposits along the Monongahela River, and deposits on terraces and in abandoned channels of older streams (Reference 5).

The soils within the borough have generally been classified as the Monongahela-Philo-Atkins association (Reference 6). They are described as deep, moderately well- to poorly-drained soils of medium texture, which lie nearly level or on gentle slopes on stream terraces and flood plains. These soils, which were derived from the underlying rock formations and deposits of former and present-day rivers, include gravels, sands and silts (Reference 6).

2.3 Principal Flood Problems

The Monongahela River usually floods between December and March, caused by a combination of heavy rain and snowmelt. Large floods, however, may occur at any time. The floods of June 1941 and August 1956 resulted from widespread thunderstorms with high-intensity rainfall. The October 1954 flood was caused by intense rainfall of relatively short duration from Hurricane Hazel. The duration of flooding on the Monongahela River may be several days (Reference 4).

Major recorded floods on the Monongahela River at Charleroi, Pennsylvania, are presented in Table 1. The gaging station at Lock and Dam No. 4 at Charleroi, located 1.8 miles downstream of Belle Vernon, was jointly operated by the USGS and the COE between August 1932 and September 1976. The gage records are maintained by the Pittsburgh District of the COE (Reference 7).

TABLE 1 - MAJOR RECORDED FLOODS ON THE MONONGAHELA RIVER AT CHARLEROI, PENNSYLVANIA

Date	Discharge (cfs)	Actual Flood[1] Crest Elevation (feet)	Approximate[4] Recurrence Interval (years)
July 11, 1888	214,000	760.02	480
March 7, 1967	158,000	759.5	31
March 5, 1963	154,000	757.3	26
March 18, 1936	153,000	756.8	25
June 5, 1941	143,000	756.1	15
October 16, 1954	141,000	755.9	14
August 6, 1956	133,000	755.1	10
March 25, 1936	133,000	755.1	10
October 29, 1937	130,500	754.9	9
May 25, 1968	127,000	752.7	8
February 4, 1939	122,500	754.1	7
March 20, 1963	121,500	754.0	6
February 14, 1948	121,000	754.3	6
January 12, 1974	117,000	751.0	5
January 27, 1978	113,000	- [3]	5
December 30, 1942	111,000	752.9	4
April 17, 1939	110,000	752.8	4
April 14, 1948	110,000	752.8	4
December 17, 1948	110,000	752.9	4
June 23, 1972	110,000	752.8	4

[1]Gage Location: October 1933 to october 1967 - river mile 41.7
October 1967 to October 1976 - river mile 41.3
October 1976 to present - river mile 24.0

[2]Estimate considered to be reliable

[3]Recorded at Elizabeth, Pennsylvania, river mile 24.0 - Discharge adjusted to Charleroi site

[4]Based on normal operation of all flood control reservoirs presently in use. Return periods based on log-Pearson Type III frequency analysis of 36 years of data

The Borough of Belle Vernon is particularly susceptible to flooding from the Monongahela River. Past floods have inundated several residences, churches and light industries in the borough. The main track of the

Pittsburgh and Lake Erie Railroad parallels the river in Belle Vernon and has been flooded several times. State Routes 906 and 711 also parallel the river and have been flooded and are expected to flood in the future.

Photographs of historic flooding within the Borough of Belle Vernon are shown in Figures 2 and 3 below (Reference 8).

Figure 2 - March 7, 1967, flood in Belle Vernon, looking upstream on Main Street.

Figure 3 - March 7, 1967, flood in Belle Vernon, looking toward the Monongahela River from Water Street.

2.4 Flood Protection Measures

Flood control projects completed or authorized in the Monongahela River Basin include: Tygart Lake on the Tygart River near Grafton, West Virginia (completed 1938); Stonewall Jackson Lake on the West Fork River near Weston, West Virginia (under construction); Rowlesburg Lake on the Cheat River near Rowlesburg, West Virginia (authorized); Deep Creek Reservoir on the Youghiogheny River near McHenry, Maryland (completed 1925), and the Youghiogheny River Lake on the Youghiogheny River near Confluence, Pennsylvania (completed 1948). The reservoirs on the Youghiogheny River have no effect on flooding in Belle Vernon, however, since the Youghiogheny River joins the Monongahela River downstream of the borough. Tygart Lake controls runoff from 1,184 square miles and Stonewall Jackson Lake will control 102 square miles. All of these reservoirs, with the exception of Deep Creek Reservoir, were constructed for flood control. All the reservoirs have secondary purposes that include flow augmentation for navigation, water supply, recreation and power generation (References 9, 10 and 11).

Presently, Tygart Lake reduces major flood crests by 2 to 4 feet at Belle Vernon. When completed, the reservoirs on the Cheat and West Fork Rivers will reduce major floods by an additional 6 feet or more. No significant protection is provided by the series of navigation locks and dams on the Monongahela River (Reference 4).

A flood forecasting and warning system is provided by the National Oceanic and Atmospheric Administration National Weather Service and the Pittsburgh District of the COE to monitor weather conditions and flows in the Monongahela River Basin. Emergency operations are coordinated through the Fayette County Civil Defense Office.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood

(one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for the flooding source studied in detail affecting the community.

Flood flows were based on a statistical analysis of stage-discharge records covering a 36-year period at Lock and Dam No. 4, located approximately 2.0 miles downstream of Belle Vernon.

The natural peak flows for the Monongahela River were estimated using the standard log-Pearson Type III frequency analysis as outlined by the U. S. Water Resources Council (Reference 12). An average reduction curve was developed from the actual flows at Lock and Dam No. 4 and the natural flows which were adjusted for the effect of the Tygart River Dam. The natural peak flows of the selected recurrence intervals were then modified based on this average reduction curve to obtain the discharges used in this study. A summary of drainage area-peak discharge relationships for the stream studied by detailed methods is shown in Table 2, "Summary of Discharges."

TABLE 2 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
MONONGAHELA RIVER					
At downstream corporate limits	5,187	135,500	167,000	182,500	216,400

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding source studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along this flooding source.

Cross section data for the Monongahela River were taken from COE soundings and topographic maps dated 1948 (Reference 13). Field checks were made if any information was questionable or if an area required specific roughness inspection and evaluation.

Roughness coefficients (Manning's "n") were chosen on the basis of field inspection and verified through the reproduction of historical floods for which high-water marks and flood profiles were obtained or measured. For the Monongahela River, the well-defined floods of 1963, 1967, 1972 and the moderate flood of 1968 were reproduced successfully using a channel roughness coefficient of 0.029 and an overbank roughness coefficient of 0.060. These coefficients were used to compute the 10-, 50-, 100- and 500-year flood profiles for this study.

The required water-surface profiles were determined using the backwater computation program 22 JL 212 (Reference 14). Starting water-surface elevations for the Monongahela River were obtained from a water-surface profile computation initiated at Lock and Dam No. 4.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed, and dams and other flood control structures operate properly and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using

topographic maps at a scale of 1:2,400 with a contour interval of 4 feet (Reference 15). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this report is presented to local agencies as a minimum standard that can be adopted or that can be used as a basis for additional studies.

The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plains. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 3).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. A portion of the floodway width for the Monongahela River extends beyond the corporate limits.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 4.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Monongahela River A	370	930	35,976	5.1	762.4	762.4	763.3	0.9

[1]Feet above corporate limits
[2]This width extends beyond corporate limits

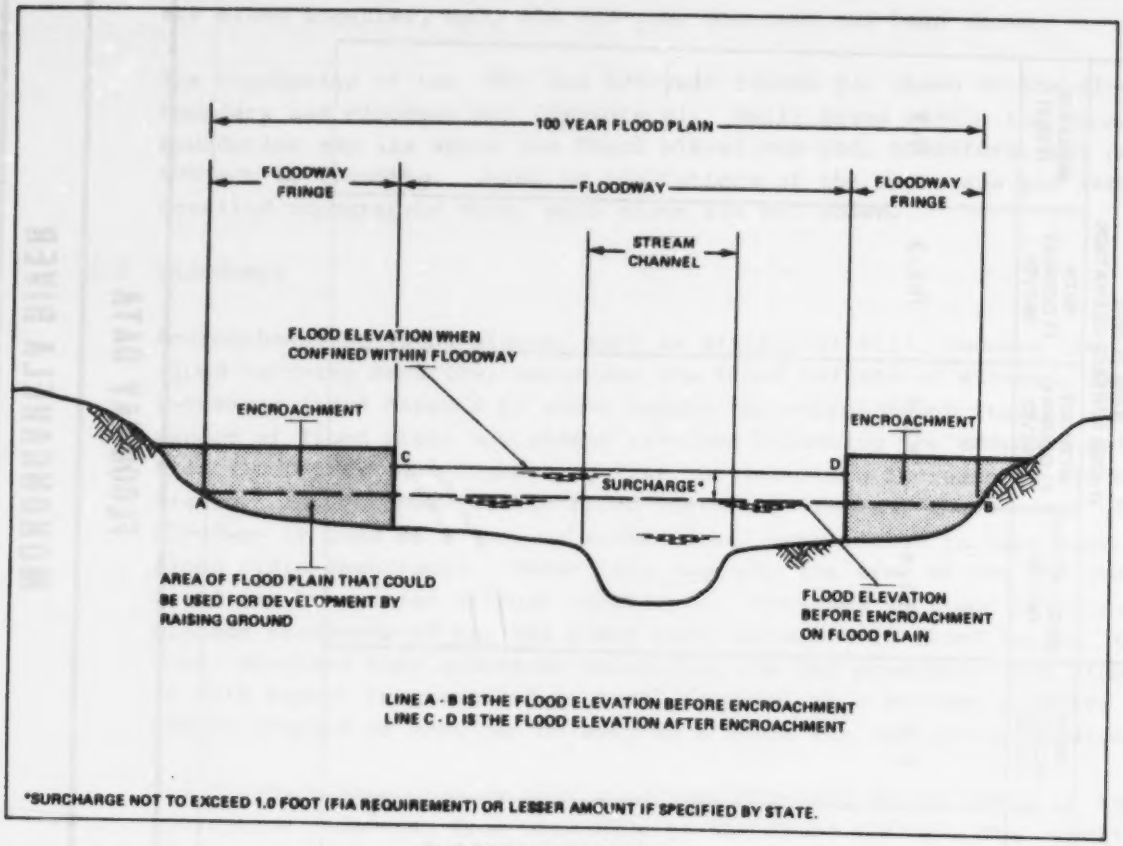
TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF BELLE VERNON, PA
(FAYETTE CO.)

FLOODWAY DATA

MONONGAHELA RIVER


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 4

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for the flooding source affecting the Borough of Belle Vernon.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not

have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding source of the Borough of Belle Vernon are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 4).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Borough of Belle Vernon was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A14: Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.

Zone B: Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Monongahela River Reach 1	01	-7.1	-1.9	+4.0	070	A14	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

BOROUGH OF BELLE VERNON, PA
(FAYETTE CO.)

FLOOD INSURANCE ZONE DATA

MONONGAHELA RIVER

Zone B (continued):	structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 4, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the Borough of Belle Vernon.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Borough of Belle Vernon is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

All the communities surrounding Belle Vernon, with the Monongahela River as a common flooding source, are being evaluated under the Flood Insurance Program. They include the Township of Rostraver in Westmoreland County, the Township of Washington in Fayette County, and the Boroughs of Speers and Dunlevy in Washington County (References 16, 17, 18 and 19). The results of this Flood Insurance Study will agree with those studies.

A Flood Hazard Boundary Map for the Borough of Belle Vernon was prepared in May 1976 (Reference 20).

The Pittsburgh District of the COE published Flood Plain Information Reports for Washington and Fayette Counties in March 1970 and August 1973, respectively (References 7 and 4). Flooding due to the Monongahela River within Belle Vernon is discussed primarily in the Fayette County report, but information presented in the Washington County report is also pertinent. Base flood elevations in this report are from 0.0 to 1.2 feet higher in this report than those presented in the COE publications. These differences are attributable to recent revisions in the discharge-frequency curves for Lock and Dam Nos. 2, 3 and 4 by the Pittsburgh District of the COE.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Room 700, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

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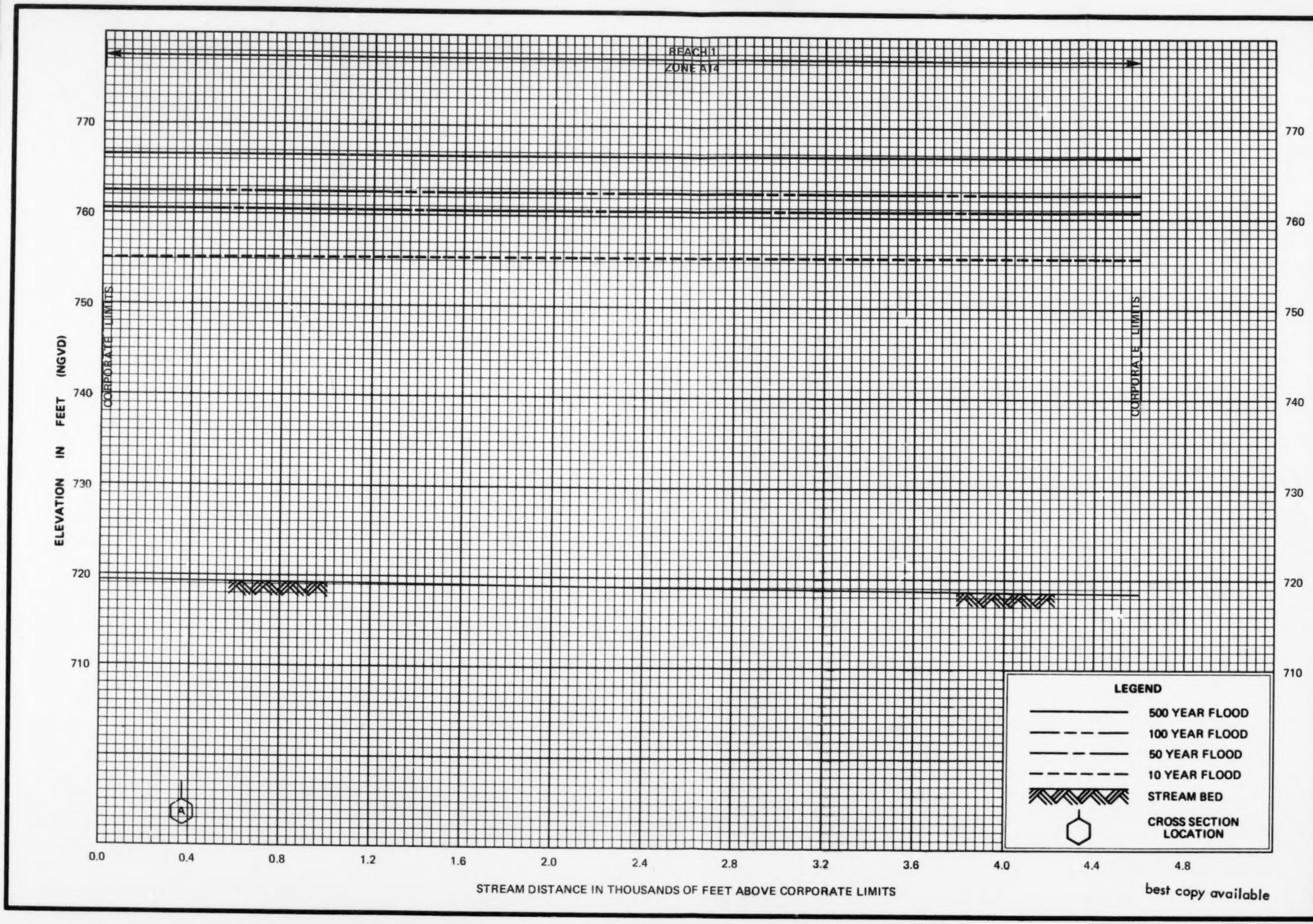

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FLOOD PROFILES

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